

What is claimed is:

1. A blood sugar level calculation method comprising the steps of:

measuring a first temperature which is the temperature of a plate that is in contact with a body surface;

measuring a second temperature which is the temperature of the heat that is transmitted from said plate to a first member disposed adjacent to said plate;

measuring a third temperature which is the temperature of the heat radiating from said body surface;

detecting light with which said plate has been irradiated;

selecting a first calculation equation from a group of calculation equations on the basis of said first temperature, said second temperature, said third temperature, and the result of detection of said light, said group of calculation equations being obtained by classifying a plurality of data sets concerning said first temperature, said second temperature, said third temperature, and the result of detection of said light by a statistical process; and

calculating a blood sugar level by using said first temperature, said second temperature, said third temperature, said result of detection of light, and said first calculation equation.

2. The blood sugar level calculation method according to claim 1, wherein said first calculation equation is selected based on a calculation equation that relates said first temperature, said second temperature, said third temperature, and said result of detection of light to a blood sugar level.

3. A blood sugar level calculation method comprising the steps of:

measuring a first temperature which is the temperature of a plate that is in contact with a body surface;

measuring a second temperature which is the temperature of the heat that is transmitted from said plate to a columnar member disposed adjacent to said

plate;

measuring a third temperature which is the temperature of the heat radiating from said body surface;

detecting light with which said plate has been irradiated;

selecting a first calculation equation from a group of calculation equations on the basis of said first temperature, said second temperature, said third temperature, and the result of detection of said light, said group of calculation equations being obtained by classifying a plurality of data sets concerning said first temperature, said second temperature, said third temperature, and the result of detection of said light by a statistical process; and

calculating a blood sugar level by using said first temperature, said second temperature, said third temperature, said result of detection of light, and said first calculation equation.

4. The blood sugar level calculation method according to claim 3, wherein said first calculation equation is selected based on a calculation equation that relates said first temperature, said second temperature, said third temperature, and said result of detection of light to a blood sugar level.

5. A blood sugar level measuring system comprising:

a heat amount measuring portion for measuring a plurality of temperatures derived from a body surface and obtaining information used for calculating the amount of heat transferred by convection and the amount of heat transferred by radiation, both related to heat dissipation from said body surface;

a body surface contact portion;

an indirect temperature detector for detecting the concentration at a position spaced apart from said body surface contact portion;

a heat conducting member connecting said body surface contact portion and said indirect temperature detector;

a blood flow volume measuring portion for obtaining information relating to the volume of blood flow;

an optical measuring portion for obtaining hemoglobin concentration and hemoglobin oxygen saturation in blood;

an oxygen supply volume measuring portion for obtaining information about the amount of oxygen in blood;

a first storage portion for storing groups of measurement value sets or a calculation equation prepared for each of said groups of measurement value sets, said groups of measurement value sets being obtained by classifying a plurality of sets of measurement values obtained in advance by said heat amount measuring portion and said oxygen supply volume measuring portion by a statistical process;

a calculation equation selecting means for selecting a first calculation equation from said first storage portion based on measurement information about said plurality of temperatures and the blood oxygen amount;

a second storage portion for storing said first calculation equation;

a calculation portion for calculating a blood sugar level by using a plurality of measurement values inputted from said heat amount measuring portion and said oxygen supply volume measuring portion, and said first calculation equation stored in said second storage portion; and

a display portion for displaying the result of calculation in said calculation portion.

6. A blood sugar level measuring apparatus comprising:

an ambient temperature measuring device for measuring ambient temperature;

a body-surface contact portion to which a body surface is brought into contact;

a radiant heat detector for measuring radiant heat from said body surface;

a heat conducting member disposed in contact with said body-surface

contact portion;

an indirect temperature detector disposed at a position that is adjacent to said heat conducting member and that is spaced apart from said body-surface contact portion, said indirect temperature detector measuring temperature at the position spaced apart from said body-surface contact portion;

a light source for irradiating said body-surface contact portion with light of at least two different wavelengths;

a light detector for detecting reflected light produced as said light is reflected by said body surface;

a first storage portion for storing groups of measurement value sets or a calculation equation prepared for each of said groups of measurement value sets, said groups of measurement value sets being obtained by classifying a plurality of sets of measurement values obtained in advance by said heat amount measuring portion and said oxygen supply volume measuring portion by a statistical process;

a calculation equation selecting means for selecting a first calculation equation from said first storage portion based on the outputs from said indirect temperature detector, said ambient temperature detector, said radiant heat detector, and said light detector;

a second storage portion for storing said first calculation equation;

a calculation portion for calculating a blood sugar level by using the outputs from said indirect temperature detector, said ambient temperature detector, said radiant heat detector, and said light detector, and said first calculation equation stored in said second storage portion; and

a display portion for displaying the blood sugar level outputted from said calculating portion.

7. The blood sugar level measuring system according to claim 6, further comprising:

an adjacent temperature detector for detecting the temperature of a plate

covering an opening end of said heat conducting member adjacent to said body surface contact portion, and the temperature of said plate, wherein:

said sets include an output from said adjacent temperature detector, and

said calculation equation selecting means selects said first calculation equation from said first storage portion based on the outputs from said indirect temperature detector, said ambient temperature detector, said radiant heat detector, said light detector, and said adjacent temperature detector.

8. A blood sugar level measuring apparatus comprising:

an ambient temperature measuring device for measuring ambient temperature;

a body-surface contact portion to which a body surface is brought into contact;

a radiant heat detector for measuring radiant heat from said body surface;

a heat conducting member disposed in contact with said body-surface contact portion;

an indirect temperature detector disposed at a position that is adjacent to said heat conducting member and that is spaced apart from said body-surface contact portion, said indirect temperature detector measuring temperature at the position spaced apart from said body-surface contact portion;

a first storage portion storing information about hemoglobin concentration and hemoglobin oxygen saturation in blood;

a first storage portion for storing groups of measurement value sets or a calculation equation prepared for each of said groups of measurement value sets, said groups of measurement value sets being obtained by classifying a plurality of sets of measurement values obtained in advance by said heat amount measuring portion and said oxygen supply volume measuring portion by a statistical process;

a second storage portion for storing said first calculation equation;

a calculation portion for calculating a blood sugar level by using the

outputs from said indirect temperature detector, said ambient temperature detector, said radiant heat detector, and said first calculation equation stored in said second storage portion; and

a display portion for displaying the blood sugar level outputted from said calculating portion.

9. The blood sugar level measuring system according to claim 8, further comprising:

an adjacent temperature detector for detecting the temperature of a plate covering an opening end of said heat conducting member adjacent to said body surface contact portion, and the temperature of said plate, wherein:

said sets include an output from said adjacent temperature detector, and

said calculation equation selecting means selects said first calculation equation from said first storage portion based on the outputs from said indirect temperature detector, said ambient temperature detector, said radiant heat detector, said light detector, and said adjacent temperature detector.

10. A blood sugar level measuring apparatus comprising:

a heat amount measurement portion for measuring a plurality of temperatures derived from a body surface and obtaining information used for calculating the amount of heat transferred by convection and the amount of heat transferred by radiation, both related to the dissipation of heat from said body surface;

an oxygen amount measuring portion for obtaining information about blood oxygen level;

a storage portion for storing a relationship between parameters corresponding to said plurality of temperatures and blood oxygen amount and blood sugar levels;

a calculating portion which converts a plurality of measurement values

fed from said heat amount measuring portion and said oxygen amount measurement portion into said parameters, and computes a blood sugar level by applying said parameters to said relationship stored in said storage portion;

a display portion for displaying the blood sugar level calculated by said calculating portion;

a communication interface; and

a control portion for replacing said relationship stored in said storage portion with said relationship acquired from said communication interface, wherein:

said oxygen level measurement portion includes a blood flow volume measurement portion for obtaining information about blood flow volume, and an optical measurement portion for obtaining blood hemoglobin concentration and hemoglobin oxygen saturation, wherein said blood flow volume measurement portion includes:

a body-surface contact portion;

an indirect temperature detector for detecting the concentration at a position spaced apart from said body-surface contact portion; and

a heat conducting member connecting said body-surface contact portion and said indirect temperature detector.

11. The blood sugar level measuring apparatus according to claim 10, wherein said storage portion stores an average value and standard deviation value of each of said parameters, and wherein said control portion replaces the average value and standard deviation value of each parameter stored in said storage portion with an average value and standard deviation value acquired via said communication interface.

12. A blood sugar level measuring apparatus comprising:

an ambient temperature measuring device for measuring ambient

temperature;

a body-surface contact portion to which a body surface is brought into contact;

a radiant heat detector for measuring radiant heat from said body surface;

a heat conducting member disposed in contact with said body-surface contact portion;

an indirect temperature detector disposed at a position that is adjacent to said heat conducting member and that is spaced apart from said body-surface contact portion, said indirect temperature detector measuring temperature at the position spaced apart from said body-surface contact portion;

a light source for irradiating said body-surface contact portion with light of at least two different wavelengths;

a light detector for detecting reflected light produced as said light is reflected by said body surface;

a converter for converting outputs from said indirect temperature detector, said ambient temperature detector, said radiant heat detector and said light detector, into parameters;

a calculating portion in which a relationship between said parameters and blood sugar levels is stored in advance, and which calculates a blood sugar level by applying said parameters to said relationship;

a display portion for displaying the blood sugar level outputted from said calculating portion;

a communication interface; and

a control portion for replacing said relationship stored in said storage portion with said relationship acquired via said communication interface.

13. The blood sugar level measuring apparatus according to claim 12, wherein said storage portion stores an average value and standard deviation value of each of said parameters, and wherein said control portion replaces the average value



and standard deviation value of each parameter stored in said storage portion with an average value and standard deviation value acquired via said communication interface.

14. A blood sugar level measuring apparatus comprising:

- an ambient temperature measuring device for measuring ambient temperature;

- a body-surface contact portion to which a body surface is brought into contact;

- a radiant heat detector for measuring radiant heat from said body surface;

- a heat conducting member disposed in contact with said body-surface contact portion;

- an indirect temperature detector disposed at a position that is adjacent to said heat conducting member and that is spaced apart from said body-surface contact portion, said indirect temperature detector measuring temperature at the position spaced apart from said body-surface contact portion;

- a storage portion storing information about hemoglobin concentration and hemoglobin oxygen saturation in blood;

- a converter for converting outputs from said indirect temperature detector, said ambient temperature detector, said radiant heat detector into a plurality of parameters;

- a calculating portion in which a relationship between said parameters and blood sugar levels is stored in advance, and which calculates a blood sugar level by applying said parameters to said relationship;

- a display portion for displaying the blood sugar level outputted from said calculating portion;

- a communication interface; and

- a control portion for replacing said relationship stored in said storage portion with said relationship acquired via said communication interface.

15. The blood sugar level measuring apparatus according to claim 14, wherein said storage portion stores an average value and standard deviation value of each of said parameters, and wherein said control portion replaces the average value and standard deviation value of each parameter stored in said storage portion with an average value and standard deviation value acquired via said communication interface.

16. A system comprising:

- a receiver portion adapted to receive a measurement data set including the temperature of a body surface, the temperature of a heat conducting member that is in contact with said body surface, the radiation temperature on said body surface, the values of a plurality of parameters calculated from ambient temperature, and a blood sugar level measured by a usual method;

- a measurement data storage portion storing a plurality of measurement data sets received by said receiver portion;

- a function data storage portion storing an average value and standard deviation value of each parameter, and a relation expression indicating the relationship between said parameters and blood sugar levels;

- a processing portion for statistically processing the multiple data sets stored in said measurement data storage portion, determining a relation expression indicating the relationship between said parameters and blood sugar levels, and storing the relation expression in said function data storage portion;
- and

- a transmitter portion for transmitting the average value and standard deviation value of each parameter stored in said function data storage portion and the relation expression indicating the relationship between said parameters and blood sugar levels.

17. The system according to claim 16, wherein said multiple parameters are calculated based on absorbance at at least two wavelengths of the light with which said body surface is irradiated, in addition to the temperature of the body surface, the temperature of the heat conducting member in contact with said body surface, the radiant temperature of said body surface, and the ambient temperature.

18. The system according to claim 16, wherein said processing portion re-calculates the relation expression indicating the average value and standard deviation value of each parameter and the relationship between the parameters and blood sugar levels when the number of the measurement data sets additionally stored in said measurement data storage portion, or the number of data items stored in said measurement data storage portion has reached a predetermined number, and updates the data stored in said function data storage portion.